2201 Washington Street

Building Performance Exchange

MASS CLEAN ENERGY CENTER

This case study is part of the MassCEC Building Electrification and Transformation Accelerator (BETA): Project Planning program, committed to helping a representative selection of commercial building types in Massachusetts reach net zero emissions by 2050. This MassCEC funded resource and more are available via the Building Performance Exchange.

Building type	Office
Location	Boston, MA
Year built	1899
Stories	4
Square footage	55,456
Energy use intensity (EUI)*	86 kBtu/sf/yr
Carbon emission intensity (CEI)*	5.12 CO2e kg/sf/yr
Decarbonization goals	Utility cost savings, Regulatory compliance, Tenant improvements

The 2201 Washington St facility in Roxbury, MA is a four-story office building, including one below-grade level, constructed in 1899 and occupied by the Boston Department of Transitional Assistance, the Daily Grocer, and other small businesses. The building is owned by Madison Park Development, LLC and managed by Hunneman Commercial Realty. Upgrades include a 1999 renovation with added insulation and window improvements, a 2020 roof replacement with solar PV, and the addition of an ERV, BMS, and partial LED lighting.

Existing Conditions

Enclosure	Walls	Roof	Windows
	Fair	Fair	Fair
Heating	VAV and CV gas-fired RTUs, in addition to gas-fired hydronic boiler providing hot water to perimeter baseboard.		
Cooling	Chiller serves hydronic cooling system. DX cooling within RTUs.		
Ventilation	Ventilation is supplied by rooftop units.		
Hot water	80-gallon gas-fired storage tank and two small electric storage water heaters.		
Lighting	30% already LED with remainder fluorescent		
Controls	Central BMS system		
Other	Commercial refrigeration for grocery store		
Renewable energy	Existing 64 kW system		

*EUI represents the annual energy usage of the building divided by the total area. CEI is the amount of greenhouse gas (GHG) emissions divided by the total area.



Key Challenges & Solutions

Lack of energy recovery ventilation

Replace existing VAV RTUs with HP RTUs that feature an energy recovery wheel to meet code and reduce loads.

Aging windows and high air infiltration

Perform air-sealing and weatherize-stripping measures to minimize air infiltration. Replace windows with triple pane low-e windows.

Aging DHW System

Replace it separately with a storage domestic hot water (DHW) heat pump water heater.

Core Decarbonization Strategy

- RTU heating creates an opportunity for cost effective heat pump replacements
- New equipment is staged over long run to align with system end-of-life and optimize upfront costs
- Air sealing and new windows addresses reported draftiness and air leakage in apartments while minimizing costly overhaul of envelope

Retrofit Measures and Energy Impacts

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Measures

Energy Efficiency & Load Reduction

Foundational Efficiency and Load Reduction:

- LED Lighting Upgrades
- ENERGY STAR appliances
- Advanced controls
- Air sealing
- Weatherstripping

Advanced Load Reduction:

- Skylight replacement
- Roof Replacement
- Window Replacement

System Electrification

Electrification Enablers:

- Electrical distribution panel upgrade
- Low temperature hot water infrastructure

System Electrification:

- Air-to-water heat pump (AWHP)
- Phased heat pump rooftop unit (RTU) replacement
- Heat Pump Domestic Hot water heater hot

Renewable Energy

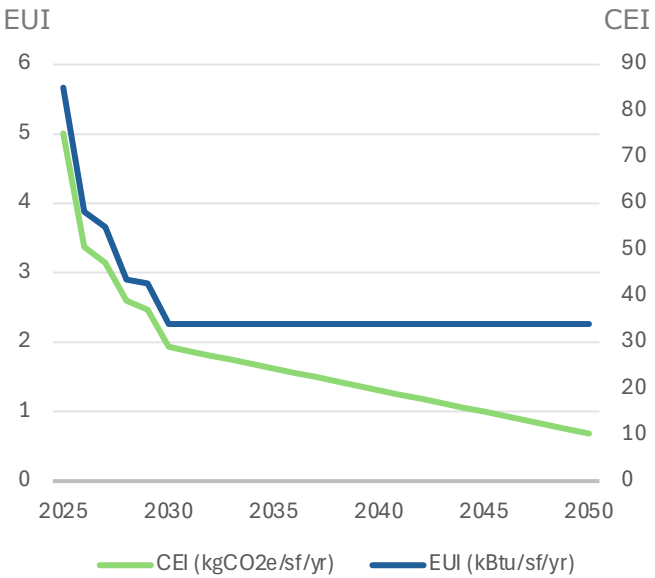
Solar:

Solar PV array installed in 2020

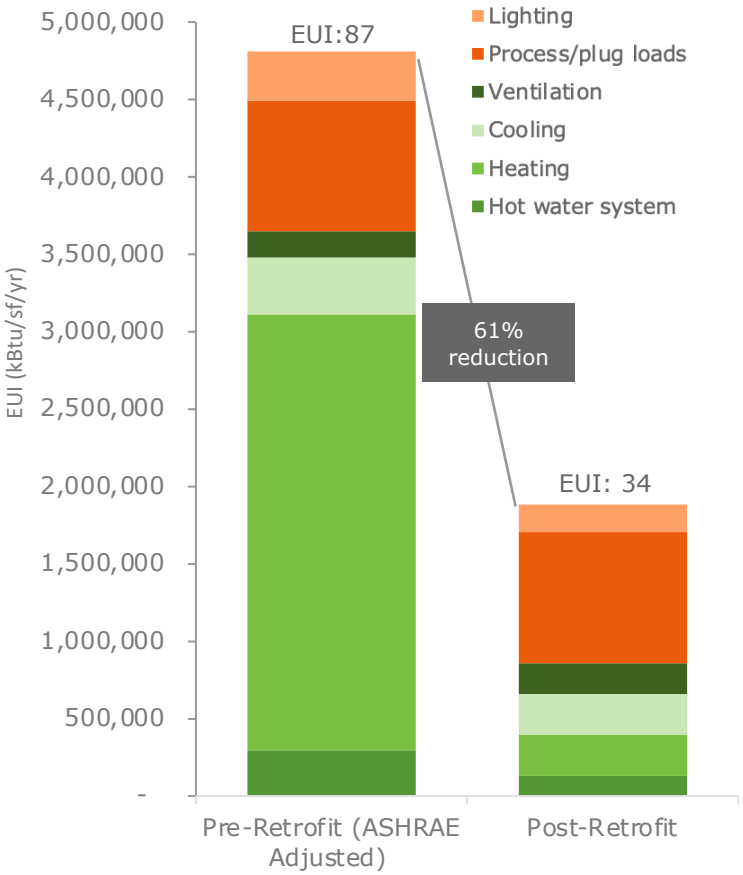
64kW system with 161 panels producing about 65,000 kWh per year

Performance Targets

The decarbonization approach prioritizes immediate energy efficiency measures and heat recovery while looking long term at heat pumps and more efficient all-electric mechanical system replacement at end-of-life. These efforts would yield the following results over time:



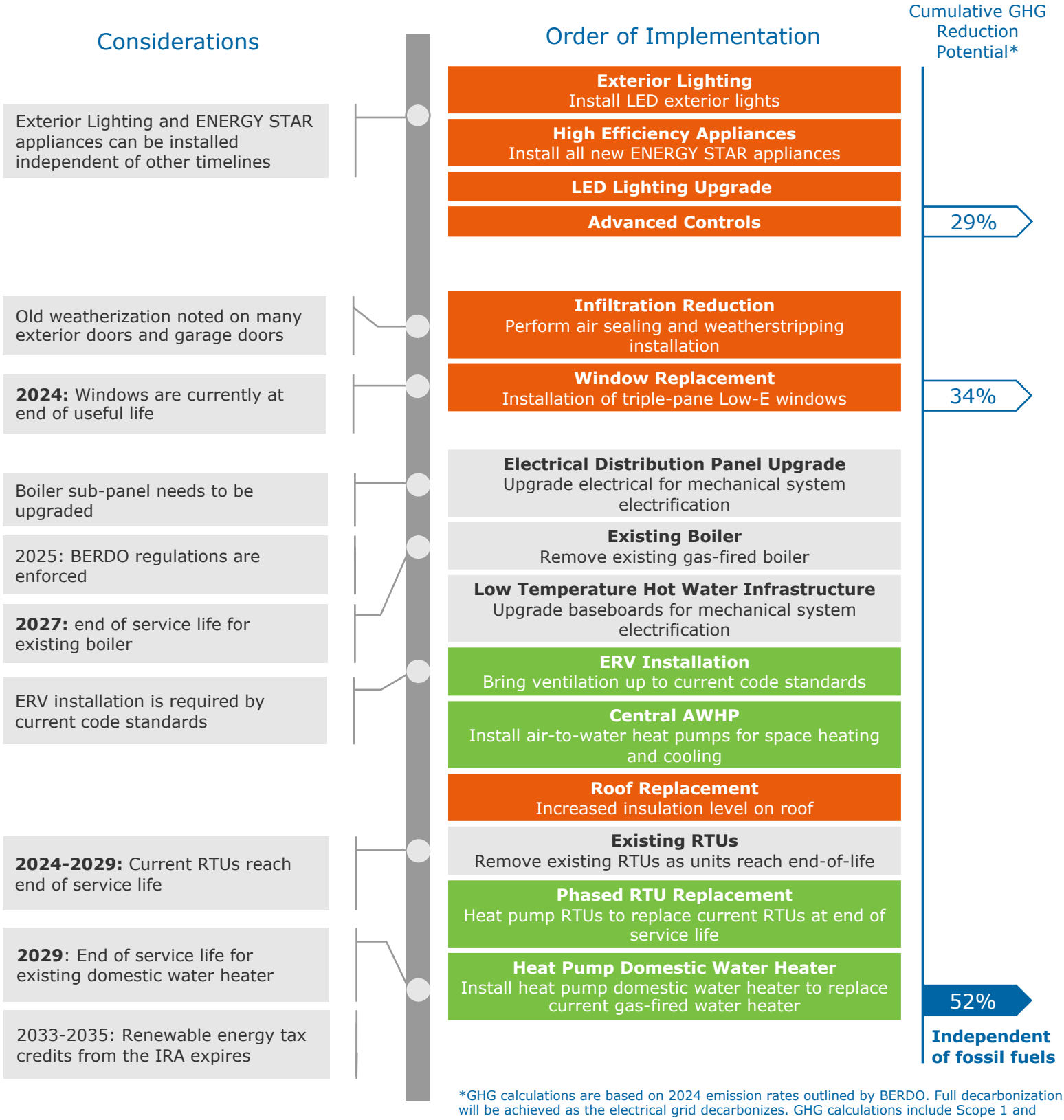
Annual Energy Use Impacts*



*The annual energy use impacts graphic illustrates an EUI before and after once all recommended measures are implemented, except for any renewable energy. The CEI and EUI shown in the performance targets account for the added benefits of renewable energy.

Optimized Decarbonization Pathway

The order of implementation provides a list of the measures and actions within the scope of this decarbonization study, and the recommendation of the order for implementing them. The measures are grouped into bundles, based on which measures must be implemented at the same intervention point. This order of implementation outlines a maximum number of intervention points, however an all at once approach is advantageous for accessing incentives, minimizing upfront costs, and reducing disruptions.



*GHG calculations are based on 2024 emission rates outlined by BERDO. Full decarbonization will be achieved as the electrical grid decarbonizes. GHG calculations include Scope 1 and Scope 2 emissions only.

Cost Analysis

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Annual Utility Impacts

Measure description	Changes in annual utility costs		
	Electricity	Fossil fuel	Net total changes
Lighting	$6,535	-	($6,535)
Ventilation	$1,622	-	$1,622
Cooling	$4,921	-	($4,921)
Heating	$10,313	($50,799)	($40,486)
Hot water system	$1,808	($3,713)	($1,804)
Total from recommended measures	**$2,388**	**($54,512)**	**($52,124)**
Renewable energy	-	-	-

Due to inconsistent data on the CHP system's operational performance, it is not modeled in this analysis. However, a rough estimate of the CHP system's annual electricity and hot water production suggest it reduces utility costs by approximately $52,100 with the current hot water system and should be considered when assessing changes in utility costs.

Lifecycle Costs*

Realizing the full value of decarbonization requires a long-term outlook that weighs upfront investments, operating costs, and financial incentives. BETA assessments identify the retrofit pathway that most effectively reduces emissions, maintains comfort, and improves performance relative to upgrades an owner would already make (the business-as-usual (BAU) scenario). This comparison highlights long-term avoided costs and risks, as well as opportunities—such as incentives—that support pursuing the optimized pathway.

Costs	BAU retrofit	Optimized decarbonization pathway	
Base building and envelope costs	$677,881.27	$398,959	Foundational efficiency and load reduction
		$1,148,925	Advanced load reduction
Mechanical costs	$971,500	TBD	Electrification enablers
		$1,600,737	System electrification
Soft costs	$164,938	$303,791	
Total upfront costs	**$1,649,381**	**$3,007,905**	
Utility incentive opportunities	-	($679,904)	
25-year total accrued utility costs	$5,222,464	$3,497,451	
25-year accrued total operating costs	$9,854,136	$7,755,690	
25-year LCCA	**$11,503,517**	**$10,763,595**	

BAU scope:
- Roof replacement
- Window replacement
- Boiler replacement
- RTU replacement
- Lighting upgrade
- DHW system replacement

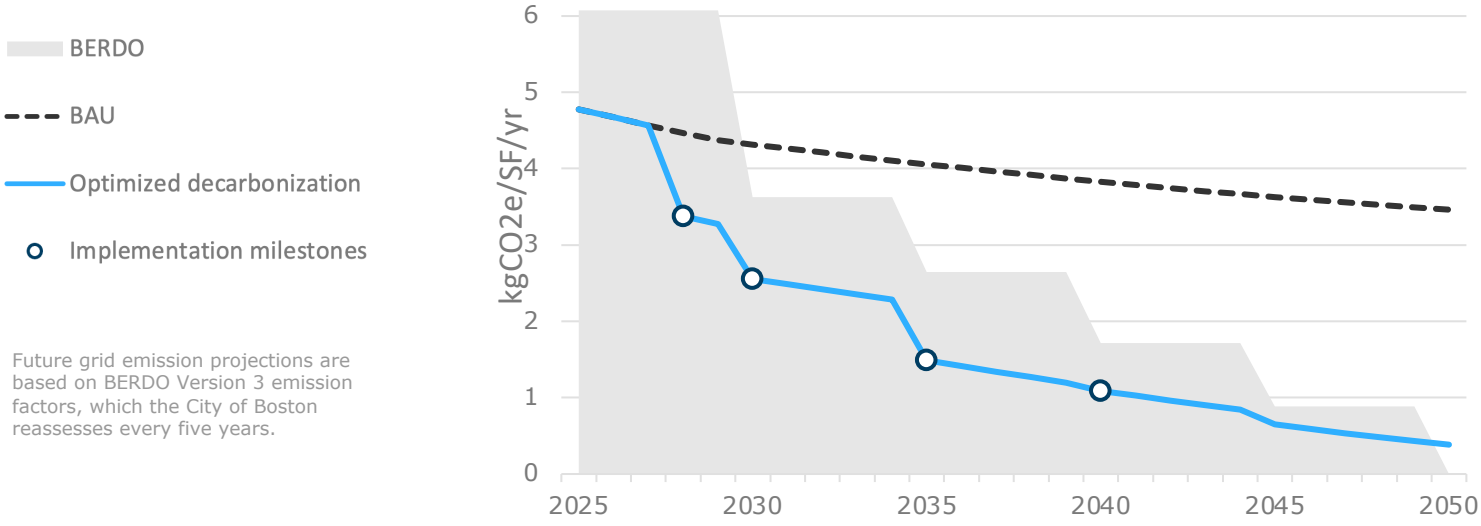
*All cost and incentive values are estimated based on industry data and rounded to the nearest $1,000. All incentives values are based on currently available programs and are subject to change over time. Forecasted operating costs include utility costs, maintenance costs, and noncompliance fees if relevant. Utility and maintenance costs reflect a 3% annual escalation rate. The BAU approach assumes necessary repairs and replacements that meet code compliance. In this case study, BAU represents the conventional gas or code-compliant versions of the decarbonization measures listed.

Decarbonization Benefits

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Emissions Goals and Benchmarking

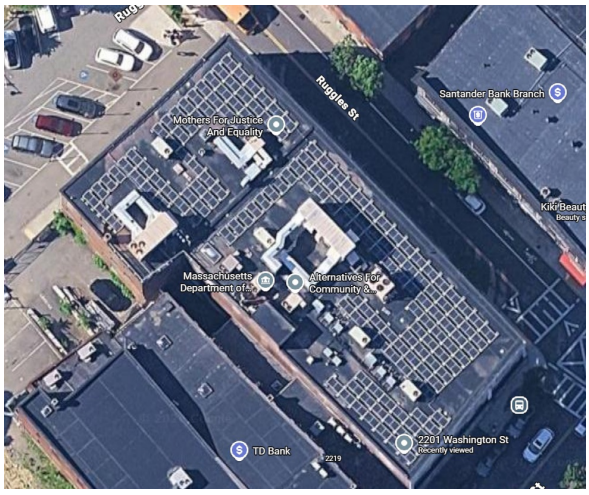
Boston's Building Emissions Reduction and Disclosure Ordinance (BERDO) applies to large existing buildings in the city and, outside Boston, serves as a useful benchmark for owners to proactively align upgrades with statewide goals. As Massachusetts targets net-zero emissions by 2050, similar policies may be adopted statewide. Achieving "zero" depends on the pace of statewide renewable energy adoption, with any remaining gaps addressed through RECs or clean electricity aggregation programs.



Future grid emission projections are based on BERDO Version 3 emission factors, which the City of Boston reassesses every five years.

Resiliency Considerations

While 2201 Washington Street is currently located in an area of minimal flood hazard, future climate analysis through FEMA's National Risk Index indicates a relatively high regional flooding risk. High-risk regions often require more robust preparations, such as mitigation strategies and emergency management efforts, to safeguard lives and property, reduce economic losses, and enhance resilience against potential disasters. Relocating the mechanical and electrical rooms in the basement to a higher floor will increase the building's resilience to flooding. In extreme weather events, ensuring the building remains operational—especially the grocery store as an essential business—may involve backup generation, on-site storage, and other emergency planning measures.



Existing Solar Rooftop Array Locations

Next Steps and Best Practices

There are many potential strategies to reduce the operational GHG emissions of buildings. As a starting point, owners are encouraged to have a solid understanding of base building information, including current energy use, carbon emissions, and long-term property goals through 2050. The data and scoping developed through this assessment can be used by design teams, including architects and engineers, to begin shaping project plans and construction timelines, while also strengthening financing strategies and incentive applications. To move from assessment to action and ensure a clear, strategic path toward decarbonization, the following next steps are recommended.

- [x] Existing building conditions
- [x] Decarbonization assessment
- [ ] Supplemental assessments
  - Structural roof assessment
- [ ] Emergency protocols
- [ ] Assemble project team
- [ ] Structure financing stack